in the western quadrants of low pressure storms. In the Gulf States 87 per cent. of the halos occurred in the eastern quadrants and 13 per cent. in the western quadrants of low pressure storms. In the Rocky Mountain and plateau regions 37 per cent. of the halos occurred in the eastern quadrants and 63 per cent. in the western quadrants of low pressure storms. In the Missouri Valley 65 per cent. of the halos occurred in the eastern quadrants, and 35 per cent. in the western quadrants of low pressure storms. On the Pacific coast 24 per cent. of the halos occurred in the eastern quadrants, and 76 per cent. in the western quadrants of low pressure storms.

From the above it appears that during February, 1890, halos occurred within the influence of low pressure storms or attending the disturbed atmospheric conditions that attended the passage of general storms; 86 per cent. of the halos were attended by rain on the same day. In regions east of the Rocky Mountains 64 per cent. of the halos were noted in the eastern quadrants, and 36 per cent. of the halos were noted to the westward of low pressure storms. In the Rocky Mountain and plateau regions but 31 per cent. of the halos were noted in the eastern quadrants of low pressure storms, and 69 per cent. of the halos reported in those regions occurred attending or following the passage of low pressure storms over the Rocky Mountain and plateau regions.

PARHELIA.

Milwaukee, Wis.: well defined parhelia were observed from noon to 3 p. m., 16th. They were brightest at 2 p. m., the sky being partly covered with cirro-stratus clouds, with haze in the upper atmosphere. Four mock suns were well defined, two on each side of the sun. The largest circle, which passed through the sun and reached to within 30° of the northern horizon, was of a whitish light, very bright, and well defined. The other circles exhibited the prismatic hues, the red on the inside or towards the sun. Mock suns were also observed at 6.20 p. m., 28th, when the sun was several degrees above the western horizon. On a line with the sun, and on each side, north and south, equally distant about 20° from the sun, were very bright spots exhibiting prismatic colors, with the red tint towards the sun. The western sky was covered at the time with broken masses of stratus and cirro-stratus clouds. On the morning of the 16th a low pressure storm of slight energy was central over the northern part of the Lake region and low pressure storms were central on the evening of that date, one over Iowa and the other over Kansas. No rain fell in the Lake region on the 16th, but was general in that section on the 17th and 18th. On the 28th a low pressure storm of considerable energy moved northeastward from the lower lake region.

Era, Idaho: on the morning of the 25th the atmosphere was filled with floating particles of frost, and as the sun rose two fan-shaped sun-dogs appeared, one on each side of the sun. They were of unusual brilliancy, the one in the north being much the brighter. The colors of the rainbow were displayed with sparkling brilliancy, and coruscating streamers were thrown out, causing the display to resemble a miniature aurora borealis. Before the sun-dogs disappeared a half circle, lying horizontally in the heavens with the bow towards the sun, was formed; its colors were of dazzling brilliancy, and sparks were apparently thrown off similar to those caused by electricity. The display lasted about one hour, and appeared again in the evening when it was less brilliant. During the 25th a low pressure storm appeared over the middle plateau region southeast of Idaho, and general rain prevailed over the eastern part of the middle plateau region on the 25th, 26th, and 27th, no general rain being reported on those dates in Idaho.

METEORS.

Brilliant meteors were reported as follows: 4th, Granbury, Tex; 11th, Green Bay, Wis.; 27th, Southport, N. C. Meteors were also reported as follows: 1st, Monticello, Iowa. 4th, Wilmington, N. C.; Eagle's Mere, Pa. 5th, Leicester, Mass. 9th, Nashville, Tenn. 12th, Vevay, Ind.; Wedgwood, N. Y. 13th, Villa City, Fla.; Beverly, N. J. 16th, Beaver, Utah. 18th, Wilmington, N. C. 21st, Cockrell, Ill.; Meridian, Miss. 26th, State College, Pa.

MIRAGE.

Mirage were observed during the month as follows: 1st, Tribune, Kans. 2d, Tribune, Kans.; Fort Maginnis, Mont. 3d, Hampton, Iowa; Spearfish, S. Dak. 8th, Spearfish, S. Dak. 12th, 15th, 16th, and 18th, Tribune Kans. 22d, Scranton, S. Dak. 28th, Webster and Woonsocket, S. Dak.

Spearfish, S. Dak.: a very fine mirage was observed to the north and northwest of this place at 8 a. m., 3d. High lands along the Belle Fouch for thirty miles or more were raised into plain view, and appeared about two or three miles distant.

SUN SPOTS.

Haverford College Observatory, Pa. (observed by Prof. F. P. Leavenworth):

Date.	Number of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Faculæ.	Definition.
	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	
Feb., 1890.										
4, 12 m.....	0	0	0	0	0	0	0	0	0	Fair; clouds.
5, 9 a. m ...	0	0	0	0	0	0	0	0	0	Poor; through clouds.
6, 12 m.....	0	0	0	0	0	0	0	0	0	Fair.
7, 10 a. m ...	0	0	0	0	0	0	0	0	0	Very poor; through clouds.
9, 9 a. m ...	0	0	0	0	0	0	0	0	4	Fair.
10, 10 a. m ...	0	0	0	0	0	0	0	0	0	Fair.
11, 2 p. m ...	0	0	0	0	0	0	0	0	0	Fair.
12, 11 a. m ...	0	0	0	0	0	0	0	0	6	Good.
13, 10 a. m ...	0	0	0	0	0	0	0	0	12	Good.
14, 4 p. m ...	0	0	0	0	0	0	0	0	3	Fair.
15, 10 a. m ...	0	0	0	0	0	0	0	0	7	Fair.
16, 12 m.....	0	0	0	0	0	0	0	0	1	Very poor.
17, 10 a. m ...	0	0	0	0	0	0	0	0	6	Fair.
18, 10 a. m ...	0	0	0	0	0	0	0	0	0	Very poor; through clouds.
20, 4 p. m ...	0	0	0	0	0	0	0	0	0	Poor.
21, 10 a. m ...	0	0	0	0	0	0	0	0	5	Fair.
22, 11 a. m ...	0	0	0	0	0	0	0	0	0	Poor.
26, 10 a. m ...	0	0	0	0	0	0	0	0	6	Fair.

Mr. C. E. Buzzell, Leaf River, Ill: solar observations were made only upon sixteen days during February, 1890. The group of January was seen February 1st, and it was the only one noted during the month. Prominent faculæ were seen on west limb on 15th.

Mr. M. A. Veeder, Lyons, N. Y.: no spots were seen during the month. Faculæ appeared by rotation on the 2d and 15th. Observations were poor or lacking on the 1st, 3d, 4th, 5th, 7th, 9th, 10th, 12th, 14th, 17th to 28th.

Mr. John W. James, Riley, Ill., and Mr. H. D. Gowey, North Lewisburgh, Ohio, report that no sun spots were seen during the month.

VERIFICATIONS.

FORECASTS FOR 24 HOURS IN ADVANCE.

[Verifications made by Assistant Professor C. F. Marvin, assisted by Mr. H. E. Williams, chief clerk of the Forecast Division.]

The forecasts for districts east of the Rocky Mountains for Febuary, 1890, were made by 2d Lieutenant W. A. Glassford, Signal Corps, and those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps.

Percentages of forecasts verified, February, 1890.

States.		States.	
Maine	81.1	Kentucky	85.6
New Hampshire	82.0	Ohio	82.9
Vermont	81.2	West Virginia	81.1
Massachusetts	79.6	Indiana	79.5
Rhode Island	84.9	Illinois	86.9
Connecticut	83.6	Lower Michigan	86.9
Eastern New York	87.6	Upper Michigan	79.6
Western New York	87.4	Wisconsin	80.6
Eastern Pennsylvania	86.2	Minnesota	82.2
Western Pennsylvania	81.4	Iowa	85.1
New Jersey	85.4	Kansas	81.1
Delaware	85.5	Nebraska	80.6
Maryland	84.7	Missouri	79.6
District of Columbia	82.7	Colorado	79.3
Virginia	84.0	North Dakota	83.4
North Carolina	82.1	South Dakota	82.2
South Carolina	86.6	Southern California*	89.7
Georgia	87.0	Northern California*	88.9
Eastern Florida	89.4	Oregon*	77.1
Western Florida	89.6	Washington*	84.2
Alabama	84.5	*By elements:* Weather	85.2
Mississippi	87.3	Temperature†	82.2
Louisiana	87.3	Monthly percentage of weather and temperature combined‡	84.0
Texas	86.3		
Arkansas	83.3		
Tennessee	89.5		

*In determining the monthly percentage of weather and temperature combined, the Pacific coast states are not included. †The forecasts of temperature in districts east of the Rocky Mountains for February, 1890, were made with reference to the maximum temperature alone; that is, a prediction of warmer or cooler indicated that the maximum temperature of the day designated would be higher or lower than the maximum of the previous day. ‡The monthly percentage of weather and temperature combined is determined by multiplying the percentage of weather by 6, and the percentage of temperature by 4, and dividing their sum by 10.

FORECASTS FOR 48 AND 72 HOURS IN ADVANCE.

Appreciating the great importance that long time predictions possess for the general public the Chief Signal Officer has authorized forecasts for forty-eight and seventy-two hours, covering the second and third days in advance. Such forecasts are optional with the predicting officer, and are only made when clearly in the public interest, and cover, in all cases, considerable areas of country, and are not confined to localities.

Percentages of verifications of forecasts made for second day in advance. Number of predictions made: weather, 50; temperature, 44. Percentages of verifications: weather, 63.2; temperature, 84.3. Weather and temperature combined, 71.0. For third day in advance. Number of predictions made: weather, 7; temperature, 7. Percentages of verifications: weather, 100.0; temperature, 14.3; weather and temperature combined, 65.7.

CAUTIONARY SIGNALS FOR FEBRUARY, 1890.

Statement showing percentages of justifications of wind signals for the month of February, 1890:

Wind signals.—(Ordered by Lieutenant W. A. Glassford.) Total number of signals ordered, one hundred and ten; justified as to velocity, wholly, seventy-six, partly, seven; justified as to direction, one hundred and seven. Of the signals ordered, sixty-three were cautionary, of which forty were wholly, and three were partly justified, and forty-seven were storm signals, of which thirty-six were wholly, and four partly justified. Twenty-eight signals were ordered for easterly winds, of which twenty-seven were justified, and eighty-two were ordered for westerly winds, of which eighty were justified. Percentage of justifications, 75.5.

Cold-wave signals.—(Ordered by Assistant Professor T. Russell.) Total number of signals ordered, four hundred and twelve; justified, two hundred and twenty-three. Percentage of justifications, 54.1.

Percentages of local verifications of weather and temperature signals reported by directors of the various State Weather Services for February, 1890.

States.	Weather.	Temperature.	States.	Weather.	Temperature.
Illinois	74.4	80.3	Nebraska	87.7	88.3
Indiana	84.0	82.0	New Jersey	82.0	86.2
Kansas	83.1	82.4	Ohio	79.0	82.0
Michigan	83.6	76.2	Oregon	80.0	85.0
Minnesota	72.0	78.0	Pennsylvania	79.0	78.0
Missouri	77.0	79.0	South Carolina	88.9	87.0

STATE WEATHER SERVICES.

[*Temperature in degrees Fahrenheit; precipitation, including melted snow, in inches and hundredths.*]

The following extracts and summaries are republished from reports for February, 1890, of the directors of the various state weather services:

ALABAMA.

Temperature.—The average temperature was 10 above the normal. Highest monthly mean, 61.4, at Mobile; lowest monthly mean, 47.9, at Guntersville; maximum, 84, at Butler, 26th and 27th; minimum, 24, at Double Springs, 9th; greatest local monthly range, 54, at Butler, Fayette, and Tuscumbia; least local monthly range, 21, at Guntersville.

Precipitation.—The average precipitation for the state was 2.14 above the normal; greatest monthly, 12.10, at Fayette; least monthly, 2.06, at Bermuda.

Wind.—Prevailing direction, south.—*P. H. Mell, Signal Corps, Auburn, director.*

ARKANSAS.

Temperature.—The mean temperature was 6.9 above that of the same month last year; highest monthly mean, 57.0, at Texarkana; lowest monthly mean, 44.3, at Lead Hill; maximum, 81, at Lead Hill, 24th; minimum, —4, at Winslow, 28th; greatest local monthly range, 76, at Lead Hill, Pine Bluff, and Winslow; least local monthly range, 50, at Little Rock.

Precipitation.—The average precipitation for the state was 4.36 above the average of last year. Greatest monthly, 11.08, at Conway; least monthly, 4.95, at Dallas.—*M. F. Locke, Commissioner of Agriculture, Little Rock, director; W. U. Simons, Sergeant, Signal Corps, assistant.*

COLORADO.

Temperature.—The monthly mean was 3 above the average for the last three years. Highest monthly mean, 38.0, at Durango; lowest monthly mean, 13.0, at Climax; maximum, 80, at Lamar and Las Animas, 4th; minimum, —27, at Breckenridge, 28th; greatest local monthly range, 100, at Breckenridge; least local monthly range, 49, at Rifle Falls.

Precipitation.—The average for the state was somewhat in excess of the average of the last three years; greatest monthly, 4.40, at Aspen; least monthly, 0.03, at Wigwam and Fort Morgan.

Wind.—Prevailing direction, west.—*Prof. F. H. Loud, Colorado Springs, director; W. S. Miller, Corporal, Signal Corps, assistant.*

ILLINOIS.

Temperature.—The mean for the month was 5.9 above the normal of the past fifteen years; highest monthly mean, 44.0, at Golconda; lowest monthly mean, 29.5, at Sycamore; maximum, 78, at Jordan's Grove, 17th; minimum, zero, at Riley and Quincy, 21st and 28th; greatest local monthly range, 70, at Collinsville, Jordan's Grove, and White Hall.

Precipitation—The average for the month was 0.48 below the normal of the past twelve years; greatest monthly, 7.47, at Golconda; least monthly, 1.00, at Gibson City.

Wind.—Prevailing direction, northwest.—*John Craig, Sergeant, Signal Corps, Springfield, in charge.*

INDIANA.

Temperature.—Like the preceding months of this winter, February was warm throughout; highest monthly mean, 45.3, at Marengo; lowest monthly mean, 33.5, at Angola; maximum, 78, at Huntingburgh, 4th; minimum, 6, at La Fayette, 9th; greatest local monthly range, 60, at La Fayette; least local monthly range, 49, at Richmond and Angola.

Precipitation.—The average for the state was 1.65 in excess of the normal; greatest monthly, 12.12, at Huntingburgh; least monthly, 1.40, at Marion.

Wind.—Prevailing directions, southwest and northwest.—*Prof. H. A. Huston, La Fayette, director; C. F. R. Wappenhans, Sergeant, Signal Corps, assistant.*

KANSAS.

Temperature.—The temperature was generally above the normal, the excess for the state being 2.2; highest monthly mean, 39.2, at Oswego; lowest monthly mean, 23.9, at Allison; maximum, 89, at Richfield, 4th; minimum, —14, at Scott City, 27th; greatest local monthly range, 99, at Scott City; least local monthly range, 62, at Morse; greatest daily range, 49, at Weskan, 4th; least daily range, 3, at Leavenworth, 27th.

Precipitation.—The average for the state was 0.64 below the normal, the deficiency being general throughout the state, the average not being reached